ELECTRICAL REVIEW

[ILLUSTRATED.]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

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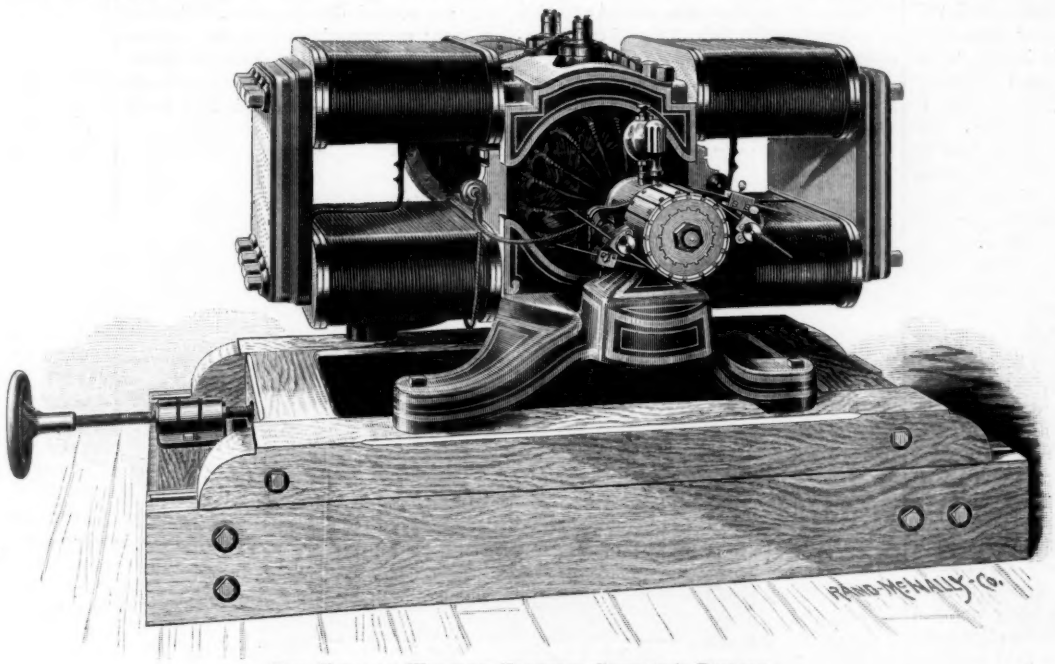
The Western Electric Company's System of Electric Lighting.

In the direction of electric lighting, the Western Electric Company has made many improvements, and its system, described in this issue of the REVIEW, possesses many features of peculiar excellence.

The base of the system—the dynamos—are of a compact pattern, with specially constructed drum armatures built up of iron annulæ, eight or ten in number, placed together so as to polarize and depolarize readily without heat. Between the sections are interposed insulating strips of asbestos. The sections are supported on parallel bars running lengthwise of the armature core, and so arranged that they may be drawn radially from the shaft until they support the rings concentrically. The rings are insulated from the bars by interposed asbestos strips. The bars are also insulated at each end from the supporting slings.

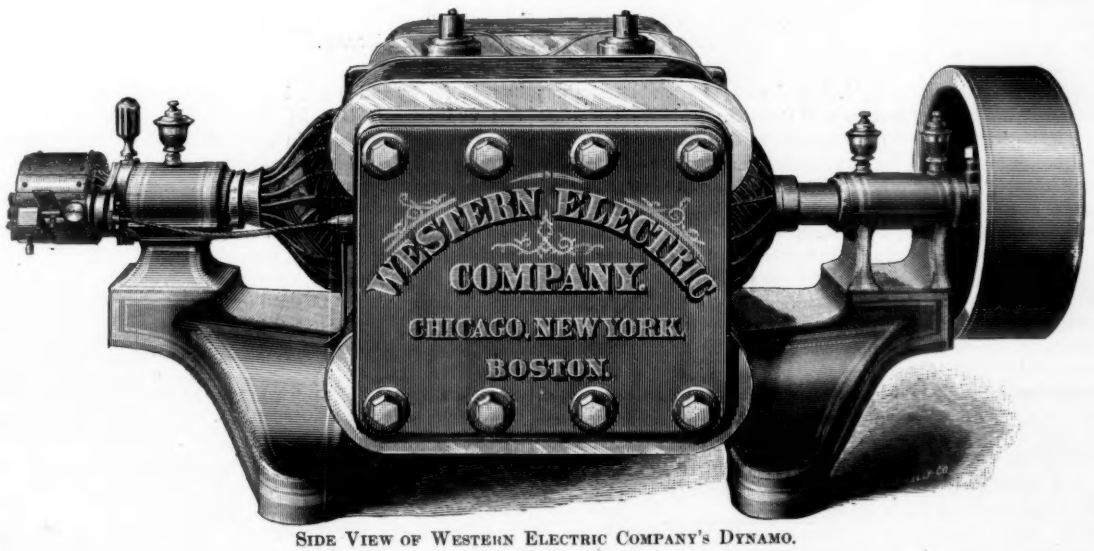


END VIEW OF WESTERN ELECTRIC COMPANY'S DYNAMO.

The armature shaft is provided with three spiders of brass having four radial arms, which support brass rings provided with lugs, between which the coils of the armature are wound. These brass rings also serve to support the parallel bars and core.

In winding, the armature is divided into a number of coils. Number one coil, as it is wound, fills entirely one of the spaces on one side of the armature; but, instead of running to the space diametrically opposite, it is placed in the two spaces adjoining that space on either side, and fills each of these spaces half full. This completes the winding of one coil. The second coil is begun at the diametrically opposite section to the first, and, spreading, occupies half of each of the sections adjoining the first section. The same method is pursued throughout, and, effecting a spread of the coil on one side of the armature and an overlapping on the other side, secures an early neutral position of the coil in passing from one magnetic field to the other. This construction secures clean running or freedom from spark at the commutator, and permits any number of lamps being run on the machine by a simple movement of the brushes, backward or forward.

From this method highly economical results on any number of lights are obtained; destructive or damaging heat, under all circumstances, is avoided, and the machine can be run even on short circuit (all lamps switched out) without injury. The freedom from spark permits the use of oil on the commutator, thus reducing the wear to a minimum.



SIDE VIEW OF WESTERN ELECTRIC COMPANY'S DYNAMO.

The field magnets are constructed with a view to securing a seat for bearings and pole plates at one time. The bearings are plain, and the device so simple that it cannot be gotten together wrong if taken apart. For taking apart, the removal of a single cap-screw is all that is necessary.

Accompanying the dynamo is a regulator, by means of which the current is regulated to the resistance of the circuit, automatically increasing or decreasing the current according to the number of lamps thrown on or off. It is self-adjusting to changes, and shows the same to the attendant.

An electric light switchboard enables the attendant to switch together any number of circuits or dynamos, or switch any dynamo on any circuit and at the same time protects the attendant from contact with the conductor, precluding all possibility of shock.

The dynamos are mounted on a strong sliding carriage, adjustable for tightening belt when running if necessary.

The Western Electric arc lamp differs greatly in internal construction and operation from that of any other system. All possible complication is avoided and the working parts are reduced in number, simplified in form, and so arranged as to reduce the liability to derangement from wear, corrosion, dust or other causes and at the same time secure a very perfect regulation of arc resistance and current strength, thereby maintaining a steady and uniform light. In its construction two electro-magnets of the ordinary form are used, having armatures attracted directly towards their poles, one of the electro-magnets being wound with coarse wire and placed in the main circuit, and the other with fine wire and placed in a circuit shunting the arc.

The main circuit magnet, when energized, establishes the arc by means of a lever working over a fulcrum supported by an adjustable spring, and is opposed by a spring that serves to effect a current regulation and avoids the necessity of a current regulator at the dynamo, to accomplish this. To the spring-supported fulcrum of the main-circuit magnet is attached by means of a lever an armature that is attracted by the magnet in the shunt circuit, and which changes its position as the magnetic strength of the magnet rises and falls, thereby maintaining a uniform arc resistance, finely regulated feed of the carbons, and consequently steady-light. An automatic cutout cuts out the lamp as soon as any defect occurs in the carbons, etc. A double carbon lamp is also used, supplied with two sets of carbons, so arranged as to shift from one to the other automatically the instant the first set is consumed. The second set is held free from feed mechanically while the first is burning, and *vice versa*.

A very neat lamp post is furnished when desired, so constructed that no additional frame is required to support the lamp. The post is made hollow, designed to carry the conductors on the inside when necessary.

A most convenient drop hanger is provided, arranged to raise or lower the lamp without counter-balancing weights. It is quite simple and consists of a roller having a central part reduced in diameter upon which the winding cord rolls. A ratchet wheel and pawl is arranged to be thrown out of engagement with the wheel by the winding cord whenever a strain is brought on the cord either in raising or lowering the lamp. Conducting cords pass around the outer end of the roller, to which the lamp is attached and permits ready adjustment to any desired

height or lowering to re-carbon. By this method of hanging all danger of dropping incident to a break in the cord is avoided. The workmanship and finish are throughout of superior character.

Electrical Motors and their Construction.

By John E. Chaster.

I must apologize for having kept so many readers waiting for this article; but business having called me away from town from time to time, I have completed the article at the earliest opportunity. I trust that few of the numerous readers interested in electrical matters have been inconvenienced.

The machine is now ready for wrapping with wire, and it should be taken in pieces, and whilst doing so it is advisable to carefully number or otherwise mark the parts that fit together, so that when finally put together no mistake may occur. Having got the motor in pieces, the field magnets are to be bound with canvas or calico, and well covered with either shellac or Brunswick black varnish, where the wire is to be wrapped on. The field magnets are to be wrapped with six or seven layers of No. 18 B.W.G. double cotton-covered wire. The exact amount got on will be determined by there being sufficient room for the armature to revolve when bolted up. About 1¼ lb. of wire will be ample for the field magnets, and seven or eight ounces of 22 B.W.G. double cotton-covered for armature. When wrapping the machine it is by far the best plan to have a small detecting galvanometer and battery, such as a Leclanché, so that in case the insulated wire should at any part touch the iron of the field magnets the fault would be detected. This is effected by putting on the first bend of wire and joining the free end to the one terminal of the galvanometer, and from the other terminal of galvanometer take a wire to one binding screw of the battery, and from the remaining binding screw the wire comes that must be made fast and in good metallic connection with the iron of the field magnets. It will thus be seen that if the wire that is being wrapped on the field magnets should in any place make metallic connection with the field magnets, the galvanometer will, owing to the closing of the circuit, immediately be deflected. Should this occur, the wire must be taken off again until the leak be discovered when it should have a piece of calico, or, better still, fine linen, wrapped round the bared place on wire, and then remounted.

Secure all the ends of the wires either to the neighboring coil or else by passing the finishing end beneath the adjoining layer and then drawing tight. All the three—viz., the two field magnets and armature, are ready to receive a coating on the insulated wire of thick shellac varnish. When dry, the machine may be finally mounted, and the ends of the field magnets so connected that the north pole of the one field magnet beds against the similar pole of the other field magnet.

When this has been ascertained, those two ends should be cut short so that there is left just enough wire to solder them together. This joint can then be insulated by binding round either cotton or tape, and carefully tucking same away so as to be out of sight as much as possible. One end of the field magnets is to be taken to one of the binding screws of the vulcanite, and the other end goes to one of the brushes of the commutator. The other commutator brush has a short length of copper wire to the remaining binding screw. The machine is now ready for trying to see how it runs. If carefully made it will revolve with a single bichromate, though to get its full efficiency it will be necessary to employ six or eight bichromate cells, each cell having a zinc surface of 3½ in. wide and 6 in. long immersed in the liquid. With a small boxwood pulley on the shaft, and about ¾ in. to 1 in. in diameter and ½ in. in width, the machine is capable of driving a small lathe, fret-saw, and all light-running machinery.

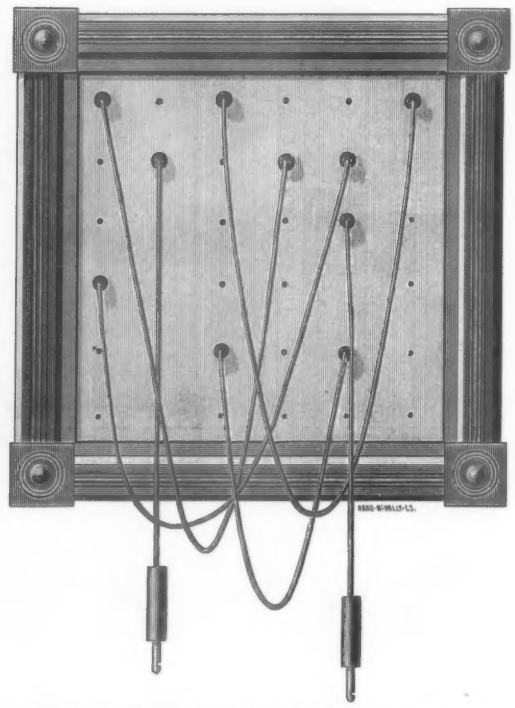
Many persons have of late been writin against the Siemens H form of armature. For a dynamo from which a large amount of electrical energy is required, it does heat after a short time of running when made of large dimensions; but for small motors it is certainly the best, considering all things, and is by far the easiest for amateurs to fit together; and if made of the very best carburetted annealed iron, it does not heat to an extent sufficient to do any damage to insulation of wire.

A suggestion was made by a Mr. Jones that I should use for my motor a clumsy imitation of the Siemens armature formed of strips of iron made in the shape of a cross. As I like to give everything a fair trial, I fitted one up in this style. When I placed this form of armature within the field magnets, I found the resulting power from the motor to be considerably less than with the Siemens H armature. This serious defect is attributable to the small amount of wire this cross form of armature holds compared with the Siemens H form. This cross form is more difficult to wrap than the ordinary Siemens, and requires more careful attention in connecting the ends of the wires to commutator.

After running it for a few hours, I found a considerable decrease of power, although the E.M.F. and current from batteries was the same as at starting. This suggested that the error must be in the armature itself.

On unwrapping the armature I found that the separate laminations of the cross form of armature had each set up a small counter rotary motion of its own, and had cut through the insulation of the cloth, and also that on the wire, so that the lower coil was short-circuited.

I trust that amateurs will be able to finish and complete the motor in a satisfactory manner, as it makes a motor of very high efficiency when correctly fitted up, and I should advise all amateurs to get the castings ready made, for making patterns of these is very troublesome, and beyond the capability of most amateurs.—*English Mechanic.*



Western Electric Company's Switch Board.

The prize of 40,000 f. offered by the French Academy for some certain test of death, to prevent people from being buried alive, was given to a physician who announced that on holding the hand of the supposed dead person to a strong light, if living a scarlet tinge is seen where the fingers touch, showing a continuous circulation of the blood—no scarlet being seen if dead. Dr. Max Busch announces that on contracting a muscle by electricity its temperature will rise and be shown by any small surface thermometer if the person is living; if it does not rise life is extinct.

Power Expended in Electric Lighting.

The London *Electrical Review* says that it may be assumed that the majority of electrical engineers are capable of determining where the various losses occur in electric lighting, from the initial power given out by the prime mover to the energy which is actually utilized in the lamps. Still, any experimental data on this subject will always be of considerable value; and when coming from such a pen as that of Mr. Gisbert Kapp, it will be doubly welcome. This gentleman, in a communication to the *Engineer*, says:

The power required for driving the dynamo is generally a very important item in the total cost of working an electric light installation.

The waste occurs throughout the whole system at every step of transmission or transformation of energy. There is a loss of power within the engine, the actual horse-power of which is always smaller than the indicated horse-power; there is a further loss in the gear by which the power is transmitted to the dynamo. In the dynamo itself there are several distinct losses, which are necessary accompaniments of the transformation of mechanical into electrical energy, and the wires which carry the current to the lamps are heated by it, and this heat has to be paid for by an increased consumption of fuel under the boiler. In the case of arc lamps a slight loss occurs in the lamp itself, by reason of the electrical energy required for the proper control and "feed" of the lamp.

In the dynamo the causes of loss of power are neither generally known nor easily traceable, and very astounding statements have at various times been put forward by makers of dynamos, or by other interested parties, without it being possible to easily verify or refute such statements.

When a dynamo is at work the external wire on the armature is being moved rapidly along, and within a very small distance from the polar surfaces of the field magnets experience a resistance which is the greater the stronger the magnetic field, the quicker the speed, and the greater the current. The energy represented by the product of this resistance into the speed of rotation is transformed into internal electrical energy, which can be expressed by the product of current and internal electromotive force. In a perfect machine this ought to equal the power applied to the spindle of the armature, but, in reality, more has to be applied, because some power is required for the mechanical friction in the journals, for churning the air, and for an additional electro-magnetic resistance which can best be described by the term "magnetic friction."

Of the total electrical energy created in the wire coils of the armature a certain proportion only is received at the commutator, where the brushes take the current off, the remainder being lost through electrical resistance. The lower this resistance the better, and in this respect an enormous improvement has, within the last year or two, been made by nearly all the manufacturers of dynamos. It was at one time thought necessary to multiply the number of convolutions on the armature in order to get up the required electro-motive force, and thus the resistance of the armature was not only high, but it also had a large coefficent of self-induction, causing considerable sparking at the brushes, which involved an additional loss of power. Now electricians have learned how to obtain a high electromotive force by simply putting plenty of iron into the armature and employing a smaller number of convolutions with a proportionate reduction of resistance, and having the additional advantage of perfect freedom from sparking. Both these results are attended by a considerable saving of power. The latest published test of an Edison-Hopkinson dynamo shows a loss in the armature of only 4.4 per cent. of the total electrical energy developed, and other machines are equally good in that respect, as will be seen from the tables given below.

Not all the electrical energy flowing from the commutator into the brushes is available for external use. Part of it has yet to be sacrificed for producing the magnetic field. How large a part, depends on the type and design of the machine, on its size, and on the quantity and quality of the iron forming the magnet cores. The latter point is of great importance. Iron of the softest quality, and plenty of it, is the secret by which this loss can be made very small. The author has found that cast-iron magnets require from 2 to 2½ times as much exciting power as magnets of soft Swedish wrought iron thoroughly annealed. The loss of energy in exciting the field magnets varies between 2½ and 15 per cent. of the total electrical energy developed. After deducting these various losses we obtain the energy actually available for external work, or, as it is technically termed, the "electrical output." To make this article of some use to practical engineers, some tables are given below containing results obtained with different machines. It is much to be regretted that neither the jury of the Vienna Exhibition, nor that of last year's Health Exhibition, have as yet published their report on dynamos; and thus we are forced to fall back on the Munich tests as the only available authoritative record of the performance of various dynamos.

In spite of its antiquity, the Munich report has considerable interest—partly because many hundreds of machines similar to those tested are now in use, and are likely to be in use for many years—for dynamos hardly ever wear out—and partly because it serves to show the progress made in dynamo construction within the last two or three years. The report on the Munich tests contains a number of very minute tables, and a short abstract containing average values is given below. All the figures are percentages of the total horse-power transmitted into the dynamo. The first column gives the loss of power due to churning of air, to mechanical friction of journals, and to magnetic friction; the second column gives the loss in armature; the third the loss in exciting the field magnets; and the fourth the actual electrical output:

Type.	Friction.	Armature	Field.	Output.
Edison....	34.00	2.76	5.80	57.44
Birgin	9.25	13.75	12.20	64.80
Schwerd ..	13.50	6.95	11.05	68.50
Schuckert.	7.90	9.15	10.90	72.05
Schuckert.	19.20	8.30	9.90	62.60

From this table it appears that with the older form of dynamo an average output of about 65 per cent. is obtainable. In modern machines the percentage recovered varies between 70 and 80, and in some exceptional cases it may reach as high as 85 per cent. Experiments which the author has made with some Crompton dynamos have shown an output of about 80 per cent. of the power applied, and other modern machines are prob-

ably equally good. As an example may be cited the Schuckert-Mordey dynamo, a test of which, kindly forwarded to the author by Mr. Mordey, is given below.

The machine tested was a D_2 Victoria compound dynamo, driven through a White's transmission dynamometer, which indicated 11.2 horse-power.

Horse-power given out in external circuit ..	9.480	or 84.2	per ct.
Horse-power lost in armature.....	.512	or 4.6	"
Horse-power lost in series coils on field magnets	.393	or 5.2	"
Horse-power lost in shunt coils on field magnets	.187		
Horse-power lost in magnetic and mechanical friction....	.628	or 6.0	"
Total.....	11.2		

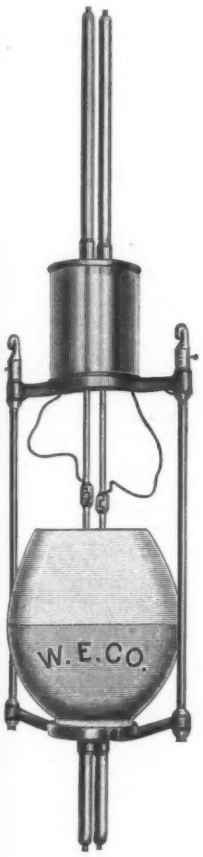
This is an exceptionally good performance, and it is probable that the machine working at any other speed or output would have shown a somewhat lower efficiency. But within reasonable limits, we may safely take it that it will yield in electrical output about 80 per cent. of the power applied.

in private establishments, the loss in the main leads must always be very small, for the simple reason that a great difference of potential at various points of the circuit would be fatal to the independence of one lamp from the other. A variation of 2 per cent. in the electromotive force can already be detected by an experienced observer, and if a greater variation were to be allowed it would be impossible to switch out a group of lamps near the dynamo without at the same time causing the lamps at the far end of the circuit to brighten up considerably.

As regards arc lighting, the case is different. The lamps are generally placed at considerable distances apart, and being connected in series, the loss of potential in the leads has no effect on the lamps as long as the dynamo is sufficiently powerful to keep

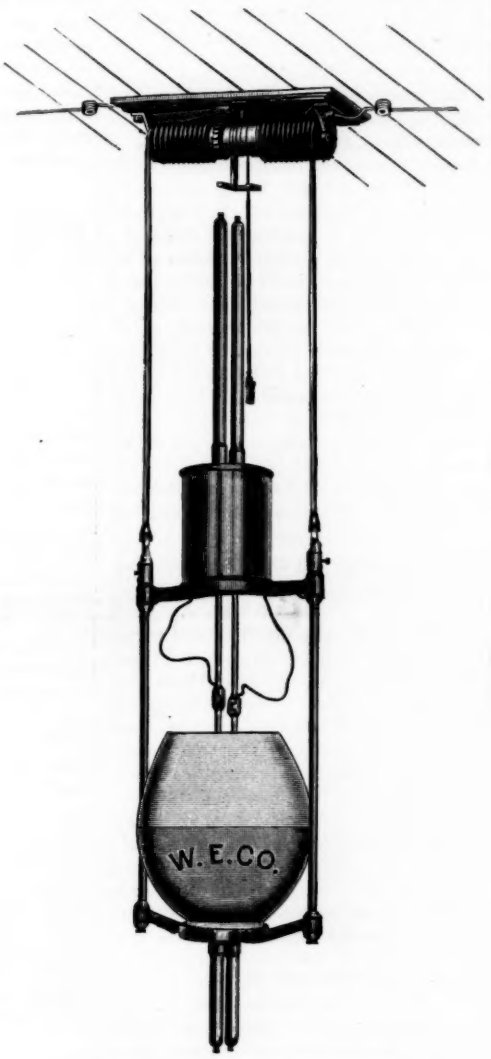
cent. of the output, or 1.75 per cent. of the mechanical energy if small machines are used, and 2 per cent. if large machines are used, thus bringing the percentage of power actually converted into light down to 68.25 and 78 respectively. Incandescent lamps are now made which have a long life if worked at 3.25 watts per candle, and with such lamps the amount of light received for each horse-power expended will be 154 candles with small dynamos, and 176 with large dynamos. On account of difficulty and danger in using currents of very high electromotive force, arc light dynamos are generally made of small or moderate size, and their output can be taken at about 70 per cent. It will therefore take 1.58 horse-power to produce a light of 2,000 candles, which is at the rate of 1,260 candles per horse-power applied to the dynamo

because the apparatus to determine the vertical variations differed much in the results which they registered. They were two iron induction variometers of Lamont, and a Lloyd balance. The first marked a variation ten times greater than that marked by the balance. Hence the observers were obliged to form an opinion on the variometers from the currents in the cable instead of calculating these currents from their indications. The exactitude of the Lloyd instrument was thus proved and the cable with a galvanometer in circuit found to be a good indicator of the variations of vertical magnetic intensity, with this drawback, that it only registered the speed with which they changed, not the values themselves. In taking the three intensities of the current obtained by estimation for the time between two readings of the instrument, they calculated the mean intensity for each half-minute during the duration of the observation, and they afterwards compared that intensity with the movements of the Lloyd balance according to the formula $b\,i = \Delta\ \mu$. From b can be calculated in degrees of the galvanometer, the intensity of the current in the

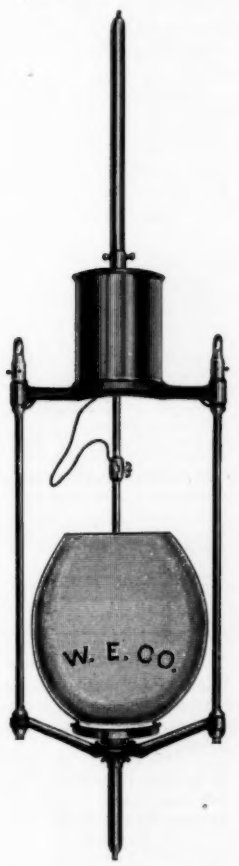


ARC LAMP.

NEW STYLE OF LAMP AND POST.



ARC LAMP, WITH SPRING ATTACHMENT.



ARC LAMP.

Whether large or small dynamos are more economical has long been a moot point with electricians, but at present the balance of opinion is rather in favor of large machines. From a number of trials the author has made with Crompton machines for 60 and 200 lights the following average figures have been obtained, giving the loss in percentage of the total electrical energy:

Loss in armature.....	14.00, 60 lights	3.55, 200 lights
Loss in field magnets ..	12 50 "	3.90 "

These losses are, however, considerably influenced by the speed of the machine. It will be evident that the slower the machine runs the larger must it be to produce a given electrical output; and since it must take more energy to excite a large magnet as compared with a small one, we must expect to find a greater loss in slow speed machines. Experience confirms this, and in the case of a 350-light machine running at only 500 revolutions per minute, the loss is found to be—in armature, 5.65 per cent.; in field magnets, 5.42 per cent.

Returning to our general problem, we have yet to consider the loss of energy in the leads and lamps. As regards incandescent lighting up the proper current. The energy required at each lamp varies with the illuminating power of the lamp, but not in simple proportion. It also depends on the size and quality of the carbon, the length of arc, and the more or less perfect feed of the lamp. To give any kind of rule applicable to all cases is next to impossible, but as a fair average we may take it that a continuous current of 15 to 17 amperes will, with good carbons, give a light of 2,000 candles measured on an angle of 45° to the horizon, the difference of potential between the carbon points being 45 volts. The shunt coil of such a lamp will require about 0.25 ampere, and the main coil will have a resistance of about 0.1 ohm, so that the total energy required for regulation can be taken as 37 watts, corresponding to a loss of 5 per cent. of the total electrical energy supplied to the lamp. The loss in the cable is a most variable quantity, and must be determined specially in each case, but for a rough preliminary estimate it will generally suffice if we allow a loss of about 3 volts per lamp. We can safely reckon that with good modern dynamos, the electrical output varies between 70 per cent. for small machines and 80 per cent. for large ones. The leads in incandescent lighting absorb 2½ per

Polar Earth Currents.

Our contemporary, London *Engineering*, says that some interesting observations have been made at the German Polar station of Kingawa, on earth currents in high latitudes. In 1882 at the St. Petersburg conference, it was agreed to admit observations on telluric currents and their connection with magnetic and auroral effects, into the programme of the polar observatories; and soon after Messrs. Siemens and Halske, of Berlin, the well-known German manufacturers, furnished the German Polar expedition with twelve kilometers of light single-wire cable, a mirror electro-dynamic, an aperiodic, and an astatic galvanometer, together with resistance boxes and batteries. In January, 1883, this cable was laid on the ice of the fjord, near the station in a circle or loop, the ends being brought into the observatory. The surface inclosed by it was 7.589 square kilometers; calling E the electromotive force, F the extent of the circuit, y the vertical intensity of magnetism, and t the time, we have $E = F\frac{dy}{dt}$. Then if we know the variations of y, we can calculate the intensity of the induced currents in the cable. But this was found impossible by the German observers, cable of the vertical intensity changes with a given speed. On the other hand, this change of electromotive force in the cable is given in an absolute manner by the equation $e = F\frac{dy}{dt}$. If the sensibility of the galvanometer is known the resistance of the cable can also be expressed, or in other words, the value of the true ohm can be found from the factor b. This new method of determining the ohm in which a single loop circuit extending over a large area takes the place by a small coil of many turns, is worthy of attention. Deposited on dry ice its insulation would be enormously high.

M. Berlier, an engineer, proposes a system of pneumatic transmission between Paris and London, involving the employment of two tubes—one for sending and the other for receiving telegrams, letters and postal parcels, weighing up to twelve pounds. The time taken in transmission would be but one hour, notwithstanding stoppages at any stations which might be established on the way. M. Berlier points out that transmission to Lyons and Marseilles could be effected still more easily than to London, there being no sea to cross. Letters and parcels sent from Paris to Marseilles would, it is said, reach that place in two hours.

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We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity and those engaged in Electric Lighting on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

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The hearing in the suit of the Bell Telephone Company against the Molecular Telephone Company for infringement was closed last week, and Judge Wallace now has the case under advisement. The closing argument for the Bell Company was made by Mr. Edward M. Dickerson.

The Bidwell Electric Railway Company has applied to the Park Commissioners in Philadelphia for permission to construct and operate a line of electric railway within the Park limits. The application was referred to the committee on superintendence and police for consideration and report.

A Kentucky judge has decided that "by telephonic means persons are as much together for purposes of conversation, and actors in what is occurring, as if they were immediately present with each other," and from this he rules that contracts made by telephone are binding, even though th parties in interest do not see each other or have never seen each other.

We learn from the *New York Herald* of Tuesday last that on the day before there was carried to the house of General Grant a new device, consisting of a small electric light on the end of a stick, with which it was proposed to examine General Grant's throat. We do not for a moment suppose that this is a new device to the eminent practitioners who are attending General Grant. That it is new to the *Herald*, whose assortment of misinformation on topics electrical is so complete and varied, is not remarkable or important. The point is, can it be true that, up to Monday last, no thorough examination of General Grant's throat had been made with the only appliance which will fully illuminate it—the incandescent light, as made and long used by leading practitioners.

The annual report of the Bell Telephone Company, which we publish in full this week, will be found of great interest. It gives, in concise and condensed form, all the essential facts, and very clearly outlines the policy of the management. It will be seen that the number of instruments outstanding on license has materially increased, as has also the general business of the company. It is evident that the management is building and planning for the future, and that its policy is a conservative one. The building of a large number of long-distance lines is clearly foreshadowed, and will doubtless be undertaken as soon as authority for an increased capital is obtained. The year has been made notable in telephonic annals by the number of judicial decisions which have been rendered, all sustaining the Bell patents.

The Baltimore and Ohio Telegraph Company has made a new departure, which will be highly appreciated by its patrons. Acting upon the recognized principle that regular patrons who give it a large amount of business are entitled to some special concession in the matter of rates—some advantage over mere transient customers—it offers to sell, for $10, books containing telegraph stamps of various denominations, representing $11.22, receivable at any Baltimore and Ohio office at their face value in payment of tolls. This is exactly the same as the commutation ticket principle on railroads, and is certainly a move in the right direction. It is an advantage to the patron, and will certainly bring an increased amount of business to the company.

We have received from Mr. C. C. Haskins, City Electrician of Chicago, a curiosity in the shape of a tariff of telegraph charges to sundry points from Toronto, Canada, dated 1846. The prices are stated in shillings and pence, and are: to Hamilton, 9d.; to St. Catherines, 1s. 3d.; to Buffalo, 2s. 6d.; to Syracuse, 4s. 3d.; to New York, 5s. 0d.; these being the rates for fifteen words. The table, which is quite elaborate, gives rates for from fifteen up to one hundred words, the tariff for a message of that length from Toronto to New York being 30s. 6d. As compared with present prices this seems high, but it must be remembered that in 1846 telegraphy was in its very early infancy.

It is understood that the works of the Schuyler Electric Light Company, now at Hartford, are to be removed to Middletown, which has offered liberal inducements to the company to move its factory to that town. "This course, if taken," says Mr. Dustin, "will be wholly due to the fact that our quarters in this city are not the most desirable, that our rent is exceedingly high and that the best encouragement has not been given the company by those people from whom it has been expected."

Two linemen, employed by the Postal Telegraph Company, were brought before the court in Brooklyn recently, on a charge of having cut wires belonging to the United Telephone Company. They were discharged on the ground that they were only obeying the instructions of their employers, and that the complainants must seek a remedy in a civil suit.

As everybody knows, there has been a very marked reduction in the price of gas to consumers during the past few years, especially in those cities and towns in which the electric light has come into use. But it is also noticed that the monthly gas bills of private parties show no decrease, and often an increase, and *pater familias* is at a loss to account for this contradictory state of things. The first impulse is to lay it to the meter, and to say that more gas is charged for than is used. But this hardly explains the trouble. The fact is that everybody, *pater familias* included, requires and has more light than formerly, and that, since the introduction of the electric light, the average eye demands three gas burners where only two were used before. Add to this the fact that the gas companies have, very many of them, allowed the quality of their product to run down, and the problem is solved.

Georgia has produced another "electrical girl," who is said to beat Lulu Hurst clean out of sight. She is from Marietta, and will no doubt make the rounds of all the large cities. Electricity seems to grow spontaneously in Georgia.

The latest French scheme is to light a coupé, inside and out, by means of incandescent lights operated by storage batteries placed under the driver's seat. As a matter of luxury it is a nice thing.

An exchange says that a new electric railway brake has been tried on the Cincinnati, Washington & Baltimore division of the Baltimore & Ohio road, with astonishing results. The trial was made with a heavy coal train of ten cars, each weighing, empty, about 11 tons, and having a tonnage capacity of 40,000 pounds. The brakes were applied only to the freight cars and caboose, there being none on the locomotive or superintendent's car, and no hand brakes were used. The loaded train, with full steam on, was put to a speed of forty-eight miles per hour on a down grade of 68 feet to the mile, and brought to a dead stop in 37½ seconds after putting on the brake, the distance run in that time being 445 yards, exact measurement. The brake acts automatically in case the train should part, signals both cab and caboose, and applies the brake to the rear portion, still leaving the engineer with complete control of the forward part.

The electric light is playing an important part in the war in Soudan. The outfit, as described in an English paper consists of six sets of apparatus, by Brotherhood, for 6-1,000-candle lights, with six spare lamps, and three spare lanterns to work on 4 ft. 8½ in. gauge, trolleys and shears, crabs, ropes and brackets, 500 yards of cable, all complete for lamps, 4,000 ft. carbons, wrought-iron dust-proof case with each set. Six sets of ditto, by Kitson & Company (fitted on trolleys 4 ft. 8½ in. gauge), each of six lights (Brush), and 800 yards of cable, with lamps, lanterns, carbons for 2,000 hours each lamp, poles, crabs, and appliances for lamps complete. In addition to this there will be for early shipment to Suakim six sets of Siemens' telegraphic apparatus (five miles in each set), with alphabetical instruments and telephones complete, two spare sets of telegraph and four spare sets of telephone instruments.

In St. Louis a decision has been rendered in the United States Circuit Court in the suit of the Baltimore and Ohio Telegraph Company against the American Bell Telephone Company of Missouri. The Baltimore & Ohio Telegraph Company applied for a mandamus to compel the Bell Telephone Company of Missouri, the company having the telephone business of St. Louis, to permit telephonic communication between it and the Baltimore & Ohio Telegraph Company. The defendant company answered that it was engaged in the telephone business in St. Louis by virtue of a license obtained from the American Bell Telephone Company, a Massachusetts corporation, that by the terms of the license under which it did business it could not establish telephonic communication with any telegraph company, other than that permitted by the licensor; and that such licensor had permitted telegraphic communication with the Western Union Telegraph Company. Judge Brewer holds, in brief, that when a man puts property in channels of commerce, he subjects that property to the laws which control commercial transactions; that when the licensor permitted the establishment of a telephonic system in St. Louis, it put such telephonic system within the control of the State of Missouri, and the courts enforcing the obligations of any common carrier; that a telephonic system, in a limited, but strict, sense, is a common carrier, and it must be equal in its dealings with all; that when it opened its telephonic system to one telegraph company, it put itself in a position where it was bound to open its system to any other telegraph company. The application for mandamus was sustained.

We learn from a London paper that certain advertising agents recently received direct from Brighton, by telephone, "the actual words and instructions respecting insertion of an advertisement in a daily paper of the 18th inst. The whole transaction only occupied a couple of minutes." "This," adds our contemporary, "is, we believe, the first practical use of the telephone for newspaper purposes over so long a distance." Our English friends evidently lack information on this subject. In this country, especially in the West, long-distance telephoning is in constant use for "newspaper purposes," including the "actual words" of news matter. In fact, it is so common that it attracts no attention whatever. From the very beginning the newspapers have been among the most liberal patrons of the telephone.

One of the most important things for electric lighting companies to consider and discuss is the relation of electric lighting to the insurance interest and to the fire departments in cities and towns. It is right and proper that underwriters should exact conditions which will protect their interests, and it is clearly the duty of officials who have to protect cities from fires, to see to it, that all possible elements of danger should be kept out. As a consequence, every city has provisions more or less exact, regulating the putting in of wires, and the insurance companies in the same way exact certain specified conditions before they will insure. These conditions, often based on misinformation, frequently fail to secure the very end which they seek to attain, and are often much more burdensome on the electric lighting companies than they need be. We believe that no electric lighting company has any desire to shirk compliance with any reasonable conditions looking to safety, and in the same way we have no reason to believe that any insurance company or fire department wishes to impose any conditions that are not reasonable. But, as a matter of fact, we believe they do. What is the remedy? It is for all three to get together, through representatives, and discuss the matter in all its bearings, and, as a result of such discussion, to formulate rules which will secure the greatest degree of safety without imposing burdensome conditions on the lighting companies. And, to bring this about, seems to us peculiarly the province of the American Electric Light Association.

In the legislature of Massachusetts, the Senate judiciary committee has reported a bill providing that all persons, associations and corporations engaged in the business of transmitting or receiving telegraphic messages for hire, shall be liable and responsible for all damages caused by their negligence or that of their servants or agents in transmitting, receiving or delivering such messages, notwithstanding any contract, written or oral, to the contrary.

General Western News.

The Chicago & Cook County Railway Company is proposing an electric elevated railway, on State Street, from Adams to Sixty-third Streets, and along Forty-third Street from State Street to the Stock Yards. The main line will measure about six and three-quarter miles, and the Stock Yards branch about one and a-half miles additional.

As the laws of the State require the consent of a majority of the landowners abutting on the proposed line of track, petitions have been prepared and placed in the office of the secretary, and interested parties are asked to sign these early, in order that the road may be in readiness for business by next winter, the company pledging itself to commence work at once when these preliminaries have been completed. The company also pledges itself to pay landowners from Adams to Twenty-second—about two miles—$10 per foot for right of way; from there to Forty-first and to the Stock Yards, $5 per foot; and on State from there to Sixty-third Street, $2 per foot.

Further pledges bind the company to use only electricity as a motive power, and to warm their cars during cold weather. This latter point can but gratify the greater portion of our citizens, for during the past severe winter the question has been one of considerable prominence, and the recording angel has had much to do writing up books against either the street railway people, or the unfortunates whose cold feet and blue noses have led them into vocal transgressions during the period between Santa Claus and St. Valentine's days.

The argument is advanced that the cable car line now in use has already outlived its day; and, as that displaced the ordinary horse car, and that in turn was a deathblow to omnibus lines, so this must naturally displace the grip, to keep up with the procession, and the grip car system be relegated to the scrap heap, or sold to some old-fogy town, some municipal purchaser of second-hand horse ferryboats, some burgh whose streets are lighted by oil lamps and the fire department is composed of one goose-neck engine and a bucket company. The petition winds up with a bit of pathos. "This company has no other aim than to build in good faith. If not permitted to build, the masses of our people will be the greatest losers; they must suffer on with the present inadequate, uncomfortable, and slow-going means of city transit indefinitely." Seriously, it is to be hoped that the proposition may be accepted, and that early; for State Street traffic is seriously interfered with by the present system of street cars, and what Blind Tom used to call the "Che-bung-ga-lung-a" rattle and jerk of the grip car is decidedly unpleasant and annoying, and is only tolerated because of the speed of its movements. At the same rate of motion the ordinary street car would be far preferable to us all.

What a fascination there is, to be sure, in owning—or in building—a telegraph line! Topeka, Kansas—which, like many another rip-roarer, "ain't no tenderfoot. Not one of the use to wases, but one of the is bes now."—purposes building a telegraph line to the Pacific. The Western Telegraph Company, organized last week at Topeka, has for its organizers E B Purcell, of Manhattan; P. I. Bonebrake, J. R. Mulvane, Joab Mulvane, and N. L. Gage, of Topeka. J. R. Mulvane was elected president, and P. I. Bonebrake secretary. Such an enterprise must necessarily rouse the ire of the Western Union and the Baltimore & Ohio, and the other "bloated bondholders" of telegraphy, and, as history repeats itself, will probably give us another epidemic of those nice little injunctions, lawsuits, and other hindrances which have heretofore been so fruitful in delays whenever an outsider has had the audacity to undertake a scheme of this nature. By and by, when Uncle Samuel concludes to take the telegraph business into his own hands, perhaps—— but we will wait and see.

McVicker's Theater has closed for the season. Already the proprietors are "tearing down their barns, to build greater." A contract has been awarded to the Edison Company, and when this popular place of amusement is re-opened, one thousand incandescent lamps will illuminate it. And the Grand Opera House, too, has just lighted up. For some time the house has been wired, and the Perkins lamps all in place, but the Mather Company have been delayed for want of a dynamo. One evening the gas was lighted, as usual, and all being in readiness, shortly before the curtain was to rise the gas was extinguished and immediately replaced by the glow of the electric light. The contrast was so striking, the movement so sudden and well planned and carried out, that the effect was truly electrical, and the audience broke into the most vociferous applause. The Grand shows up wonderfully under the new lighting. This is the second plant of the Mather Company in the city.

The new Board of Trade building is being wired for Edison lights, in addition to the arc system, of which mention was made a week ago.

The Common Council of Chicago has for some time been practicing Græco-Roman wrestling with the electric light question, apropos of a plant for the new City Building, with branches leading through the two tunnels—the Washington Street line under the south branch to the west division, and the La Salle Street line under the Main River to the north division. The struggle has been protracted and laborious, but, despite the jeers and sneers of its opponents, the appropriation of $41,375 is carried. Somewhere about 1,500 16-candle lamps will be necessary to accomplish the desired end, of which, say, 300 will be required for the tunnels, and the remainder for the City Building. It is assumed that two engines and four generators will be needed for the plant, which will be situated in the basement of the building. Only one-third of the lamps in the tunnels will be required during daylight, while at night these will be all turned on. The building lights, according to the estimate, will be run an average of three hours per day of twenty-four hours. At the meeting on Monday night the following order prevailed:

"Ordered that the Controller is hereby directed to enter into a contract with the Western Edison Light Company, in accordance with the proposition of the said company, dated December 26, 1884, in regard to lighting the buildings and tunnels of the city, for the sum of $41,375."

The advantage of electric light over gas in the present dismal and foul, unpleasant tunnels, can hardly be overestimated. With pure, better light, air devoid of noxious gases, smoke, and flickering dimness, these convenient highways, especially during the summer season, when the bridges are almost constantly on the whirl for the passage of steamers and vessels, may once more become popular as thoroughfares, especially for pedestrians. At present they are comparatively unused and avoided, save by some unfortunate whose time is of more importance than the average traveler, a fugitive from justice, or a belated omnibus striving to make a train.

This time it was sewer gas instead of carburetted hydrogen. On Monday last, March 30th, Mr. W. C. Hopkins, superintendent of construction of the Postal Telegraph Co., while engaged in inspecting the company's conduit at the corner of Clark and Jackson streets, was overcome by the escaping sewer gas and rendered insensible. He was rescued by one of his assistants, and will recover, but the warning should not be unheeded. What with the filling of these leaky underground pipes with sewer and burning gas, it will soon come to the knowledge of telegraph, telephone and electric light companies that gas-proof, as well as waterproof conduits, are the only proper things to use, and the sooner a thousand and one leaky inventions, so assidulously brought to the front by inexperienced and electrical cranks, are relegated to the silent tomb, the better for humanity. If interested parties desire to keep clear of legislative enactments in such matters, they must do better work in this line, or the crack-brained chronic of some State legislature, in one of his bi-annual spasms to tax some corporation, will get after them. Prevention is better than cure.

In Lincoln Park, in this city, there are nearly ten miles of overhead wire, with some forty lamps lighting the park. The engineer in charge tells me that he experiences wide ranges of adjustment at the dynamo for which he cannot account It seems easy of explanation. The wires much of the way are run upon one set of poles, at the extremes of an ordinary two-wire cross-arm, and the whole circuit is within but a short distance of the lake. In a warm, bright day the lake air fills with the moisture of evaporation, and the difference of temperature between land and water after nightfall brings this ashore in a landward breeze. The moisture collects on the painted benches of the park, rendering these, not damp, but wetter than would be the result of the heaviest dew. There are several lamps, suspended by cords attached to stay-wires, over road crossings in the park. Underwriters' wire is not proof against dampness, and the electric light people here tell me that the inspector has sometimes found quite heavy grounds where lamps were suspended from the iron truss rods of the roofs in buildings where there was a steam escape. The moisture in such a case is but a minute fraction of the quantity that often pervades the park when the fog horn is performing one of its summer evening solos. As one form of these "baby jumpers" is dependent on electricity for the uniformity of its gentle pulses, the following extract from a local poem may be admissible here:

"Crashing through the quiet midnight
Bawls that booming, bellowing horn,
Till I wish the inventor's mother 'd
Died before the cuss was born.
Waking all the puny nurselings
With its whooping howl forlorn!
May the blest recording angel
Blackball him who made that horn."

Mr. Sperry, the inventor and electrician of the company which bears his name, is reported dangerously ill, the result of overwork and under-recreation. The hosts of personal friends of Mr. Sperry will rejoice and congratulate him should he recover speedily, as all hope he may, and will mourn his loss sincerely should his malady terminate fatally.

Mr. C. H. Summers, who touched off one of the Western Union's underground gas cannons, is doing well, and will soon be at his post again.

The Board of Trade Market Committee, at the meeting of directors on Tuesday, March 31st, announced that they were now receiving daily reports of consols quotations by cable and Western Union direct from London at a cost of $10 per day, and were authorised to continue as long as expedient at these figures. Quite a trade has sprung up here in these securities, owing to the war flutter in Europe.

The general turning out of the firemen from warm beds at every night alarm, false or true, has for a long time been discussed as a useless expenditure of physical energy, and means of relief have been repeatedly canvassed for the welfare of the men. Prof. John P. Barnett, the electrical head of the fire organization, has hit upon a plan which has been in experimental use in two of the fire-houses with most perfect and excellent success. A hand-switch, in charge of the man on watch, is thrown over at turning-in time, and cuts out all the alarm bells, leaving only the register in circuit. If the alarm is one which calls for that particular company, the switch is instantly thrown open by the watch and the men are turned out. Otherwise, the men know nothing of the alarm, and sleep quietly. A record is made of the alarm, as usual, and even the horses, who are ever on the alert, stand in the stalls as if nothing had happened. As a result, the men and animals spring to their posts with more than former alacrity in case of a call, for under the new arrangement every such alarm means business. The intelligence of the horses is plainly evidenced in their appreciation of this fact, and the department is the gainer in time under the new arrangement. It is probable that the switch will be placed in all the houses of the fire department.—Chicago, April, 1885.

It is stated that a mortgage for $300,000 has been filed in the record office of Baltimore, by the Bankers & Merchants' Telegraph Company to the Farmers' Loan and Trust Company of New York, payable in 1913. The mortgage is to secure bonds for the payment of indebtedness and to extend the lines of the company.

At a meeting of the stockholders of the Eastern Electric Company, held at the Sheridan House, in Elizabeth N. J., on Saturday, 4th inst., the following named persons were chosen directors, to wit: Hon. Robert S. Green, Elizabeth; Dr. N. A. Johnson, Easton, Pa; George S. Bowen, Chicago; F. M. Waterbury, Elizabeth; W. H. Stillman, Elizabeth; W. H. Gillett, Elizabeth; James McK. Graeff, Elizabeth. The directors then elected Hon. Robert S. Green, president; Dr. U. A. Johnson, vice-president; F. M. Waterbury, treasurer; J. McK. Graeff, secretary, and W. H. Gillett, superintendent. This company is organized with a special view to the introduction of the Van Depoele system of electric lighting; also their system for operating surface and elevated railways, and the transmission of power by electricity, as well as the construction of iron towers for the elevation of the electric lights for the public lighting of cities, parks, docks, railway yards and lighthouses, etc.

Magnetic Induction.

The following experiments show that the law of attraction of horse-shoe magnets departs from that of *inversely as the square of the distance*, in proportion as the armatures *fail to evoke the maximum force of the magnet.*

A permanent horse-shoe magnet was used, composed of two magnets bound together, each bar being about $\frac{9}{32}$ in. thick, $1\frac{1}{4}$ in. wide, and 10 in. from poles to *U*. The distance between the poles being about $\frac{7}{16}$ inch They weigh together 73 ounces, and lift about 24 pounds.

Slips of cardboard, about $\frac{1}{60}$ in. thick were used for separating the armature from the poles.

The first number in each of the following scales represents the portative force, in ounces, with one slip intervening; and the numbers following are the results of successive additions of slips.

First experiment, with armature $1\frac{1}{16}$ in. wide, $\frac{1}{4}$ in. thick, $2\frac{5}{16}$ in. long, at back, and $2\frac{3}{8}$ in. at face; which evokes nearly the maximum force. Weighing about 3 oz, and placed edgewise:

101.5, 47.5, 29.5, 19.5, 16, 13.5, 12, 10, 9, 8.5, 8.

Second experiment, with armature, $1\frac{1}{16}$x$3\frac{5}{8}$x$\frac{1}{16}$in.; weighing about $\frac{1}{4}$ oz.—edgewise also:

13, 9, 6, 4.5, 4, 3.8, 3.5, 3.3, 3, 2.7, 2 5.

Third experiment, with a piece of wire $2\frac{1}{16}$ in. long, and $\frac{5}{32}$ in. diameter; weighing about $\frac{1}{4}$ oz:

13, 10.3, 7.8, 7, 5.7, 5, 4.7, 4.3, 4, 3.7, 3, 4.

The magnets were then disconnected from each other, and the following results obtained by using the 3 oz. armature; which developed all the attraction available at the respective distances:

37.5, 17, 11, 8, 5.5, 4, 3

At this point—the weight of the armature having been reached—the experiment was discontinued, for want of a suitable balance; but it is sufficient to show that the law of *squares* does not apply to horse-shoe magnets.

These experiments were made somewhat hastily by the writer, with such appliances as were at hand, in order to obtain for himself data for which he had sought in vain through all the literature upon the subject.

The results obtained suggested the possibility of increasing the efficiency of dynamos and motors by using a greatly increased relative strength of field; and indicate the rule to be followed wherever it is desired to obtain the maximum work from a given weight of armature.

WM. B. COOPER.

Philadelphia, March 25, 1885.

Telephonic News

⁂ A gas engine furnishes the power for the generators at the Milwaukee telephone exchange, and does it very satisfactorily.

⁂ The Milwaukee telephone exchange comprises 1,380 subscribers, and is the center of a system of toll lines that connects with 140 towns, the farthest being 210 miles north.

⁂ Aluminum is sold in leaves like gold, and it has been employed in Leyden jars instead of tin foil. Its application in leaf form is, however, by no means confined to that use.

⁂ The music at the Brussels Grand Opera House is transmitted by telephone to the royal residence at Ostend. Dwellers in royal residences, it will be seen, have their trials as well as common folk.

⁂ The newest wrinkle, telephonically, is that purposed in Canada, viz., to connect the telephone exchanges by means of phantom trunk lines, the wires being supplied by the telegraph company, and used simultaneously for both services.

⁂ The strike at Oliver & Roberts' wire mill, at Pittsburgh, has taken a new turn. All the creditors of the company having signed for the extension, Major Bent, of Steelton, and John S. Slagle, of Pittsburgh, last week assumed charge as trustees.

⁂ It is stated that the subordinate telephone companies in Mexico are reducing their capital to a more practical basis, and the parent company could do worse than imitate them. The latter is finding profitable employment for net earnings in building private lines.

⁂ A Falls Village correspondent writes: Neighbor L. was lame. He telephoned for Dr. Q., who came to see him a few times without satisfactory results. Thereupon his son told him he had better telephone for Dr. X. "No, sir!" was the emphatic reply; "I don't want any more —— telephone doctors. You hitch up the old mare, and go and get Dr. X." Neighbor L. is now getting well, but still attributes Dr. Q.'s failure to cure him to the telephone.

⁂ The suit against the Molecular Telephone Company for infringement on the Bell patents was continued before Judge Wallace, in the United States Circuit Court last week. His desk, as well as that of the attorneys interested, was covered with electrical and mechanical instruments representing the telephone in its various stages of development. Chauncey Smith, counsel for the complainants, continued the presentation of his case, and Edward M. Dickerson, his associate, explained the mechanical devices. The substance of the argument was that the inventions of Reis and the rest were circuit-breaking instruments and incapable of transmitting speech when operated in the manner described in published accounts of their day. Although some of the expert witnesses testified that they could make the old machines talk, Mr. Smith claimed that they had declined to make the test in presence of witnesses.

Wheeler H. Peckham, representing the defendants, referred, in opening his side of the case, to the statement of his opponent that the Reis instrument was simply a make-and-break instrument, like, for instance, the Morse key. He claimed that the written descriptions covered an instrument which transmitted amplitude as well as intensity, thus giving quality to the sound. Quality in the connection used was defined as that feature of sound which rendered the hearer able to recognize a voice or to distinguish between the music of different instruments. A simple make-and-break instrument, it was stated, does not transmit quality, but simply pitch. The rapidity of vibration is reproduced without regard to the range or distance of the vibration.

The Annual Meeting of Stockholders of the American Bell Telephone Company.

FULL TEXT OF THE DIRECTORS' REPORT—INCREASING THE CAPITAL STOCK.

The annual meeting of the stockholders of the American Bell Telephone Company was held in the New York Mutual Life building last week. After the reading of the call and the usual preliminary business, the report of the directors was read by the president, as follows:

BOSTON, March 31, 1885.

To the Stockholders:

Telephone business in the year ending December 31, 1884, has shared the dullness which characterized most branches of industry during the same period. Nevertheless, the increase in the number of subscribers and the telephones in use has continued, although at a diminished rate.

The following comparative statement gives the statistics for the year, which are substantially correct, although exact figures in regard to some of the items cannot be ensured, as a considerable portion of the properties are not under our direct ownership and control.

EXCHANGES.

	1883.	1884.	1885.	Inc. over 1884.
Exchanges	725	906	764	*142
Branch offices	345	419	481	62
Miles of wire on poles	.....	.....	88,441	.....
Miles of wire on buildings	.....	.....	11,886	.....
Miles of wire underground	.....	.....	1,825	.....
Total miles of wire	68,571	85,896	101,592	15,696
Total circuits	74,484	97,422	107,268	9,846
Total subscribers	97,728	123,625	134,601	10,976
Total employes	3,716	4,762	5,162	400

EXTRA-TERRITORIAL LINES.

	Jan. 1, 1883.	Jan. 1, 1884.	Jan. 1, 1885	Inc. in 1884.
Number of lines	247	598	826	228
Miles of pole lines	6,154	29,592	25,766	5,174
Miles of wire	13,653	29,359	35,631	6,274

* Decrease.

Instruments —In the hands of licensees under rental: December 10, 1882, 237,728; December 20, 1883, 298,580; December 20, 1884, 325,574; increase during year, 26,994.

The average daily number of exchange connections in the United States is 697,966, or a total number per year of 251,267,760, the subscribers paying, according to the size of the exchange and the character of the service, from 3.1 to 5.7 cents per connection. The average daily number of extra-territorial connections (that is, connections between a resident of one exchange district and a resident of another exchange district) is 7,526, or a total number per year of 2,709,360. Our share of the receipts from extra-territorials and toll business has increased nearly 50 per cent. over the receipts of the previous year. It will be noted that during the year there was a net gain of 10,976 subscribers in the exchanges, with an increase in miles of wire of 15,979. As a rule, all the larger exchanges have a steady growth, and there seems no reason to doubt that this will continue for some time to come. On the other hand, there is a pause in building exchanges in small places, and some 78 of these already started have been for the present given up, while 61 new ones have been established. The establishment of these systems in small towns was probably pushed too rapidly, in view of the stagnation of general business which followed. Many of these now abandoned will be restored upon a revival of business, and others can be put into operation under a system which is being worked out for small exchanges without a central office, and which, if as successful as we hope, will carry the telephone into a large number of towns and villages where it is now impossible to place them upon a paying basis. The table shows an apparent decrease of 142 in the number of exchanges reported, but 125 of these have been redistricted as branch offices, and are still in operation, while 63 branch offices have become toll stations.

The process of taking the wires from housetops and placing them on pole lines has continued, and now there are in the exchanges 88,481 miles upon poles and only 11,886 miles upon buildings. Great progress has been made in getting the heavy overhead lines into aërial cables in the cities. This is an important step, and one that is materially reducing the unsightliness of the telephone systems, while adding to the safety of the wires and reducing the cost of maintenance. There are now 4,300 miles of wire in 69 miles of aërial cables in use. Some progress has been made in getting wires underground for short distances in the cities, and 1,225 miles of wire under ground are now reported. In New York the legislature, against the recommendation of the Roosevelt committee, to whom the matter was referred, passed an act requiring telephone companies in cities of over 500,000 population—that is, in New York and Brooklyn—to place all wires under ground before November 1, 1885. This is wholly impracticable, for several reasons. In the first place, no method is known by which entire telephone exchange systems can be worked under ground, although for limited distances and in certain localities fairly satisfactory results can be obtained. Even when the method is discovered, part of the wires must be overhead for distribution from central points and for reaching places where subscribers are so few that the cost of going underground will be out of all proportion to the price they could pay. Again, to place even the bulk of the 6,639 miles of wire in the New York and Brooklyn systems under ground in one year, would involve the tearing up all at once of most of the streets in those cities, and would not for a moment be permitted. In New York, however, some important underground work will be done this summer, the results of which will possess great interest for our company, and, if favorable, we expect to follow them up with extensive improvements in this direction.

The financial year of our company has been changed so as to end December 31, and the treasurer's statement is therefore made for ten months to that date. The statement shows gross earnings for the ten months from all sources of $2,067,543.97, and net earnings of $1,380,165.45, which, with the balance of income from the previous year, $348,884.17, and miscellaneous credit items, $34,918.45, gives a total of $1,763,96.07. From this have been paid regular dividends of $1.152,252, and an extra dividend, $288,-063, and the balance of $323,653.07 carried to surplus account. Adding the net earnings for January and February, 1885, to that of the previous ten months, would make the net earnings for twelve months $1,710,892.69, as compared with $1,475,431.37 in the previous year.

We have received during the year $3,051,-150 in stock of licensed companies for licenses, and $107,450 for cash paid, and have now a total of $22,125,173.36 in stocks. As we have sold our licenses to these companies, we have charged the stocks received in payment to "stocks" account, and credited the amount to patent account, profit and loss. When the amount of stock, therefore, amounted to no more than the value of the patent rights upon our books, the patent account appeared upon the credit side, where it now stands at $9,540,129.31, as "patent account, profit and loss."

The report of the auditing committee is appended.

Nearly all of the licensed companies are in good condition, and many of them continue to pay regular dividends in spite of the general dullness. It has not, however, been a year when new enterprises of any kind could be easily promoted, and, in common with other industries, the telephone companies have found it difficult to sell stocks or bonds for their construction purposes. It has been probably as much due to this as to the lessening of the demand for telephone service that our output of instruments has decreased. Most of the companies have met this condition of things by applying their net earnings in part, and in some cases wholly, to their new construction. The result of this conservative policy, although temporarily disappointing to stockholders, has been to materially increase the intrinsic value and earning capacity of the properties, and in view of the importance of an early occupation of the field while numerous infringing claimants were striving to gain a foothold, we have no doubt the policy was the right one. How far it should be continued under the more favorable conditions that now prevail is to be carefully considered by each company.

The amount of net earnings applied to new construction in those of our licensed companies in which we hold stock is stated by our auditor to be $806,633.97, out of a total spent for construction in 1884 of $1,505,-907.64.

The absence of revenue to our company from its investment in the New England Telephone and Telegraph Company is noticeable, and is owing to the fact that we have been obliged to use the net earnings of Boston, which, but for the consolidation of the Boston exchange with several New England companies, would have been a constant source of income to us, in the reconstruction of the exchanges and lines outside of Boston. From this it will be apparent that the charges made against the American Bell Telephone Company, of having gained an advantage over the New England companies by the consolidation, is so far from being true, that we have actually lost money by the transaction. The New England Company has earned in the year ending December 31, 1884, gross, $912,621.75, and net, $222,441.63, of which $192,098.77 has been spent for construction.

In Canada the minister of agriculture has declared the Bell patent void on account of alleged failure to comply with the law requiring manufacture in Canada of patented articles, and with another requiring that such articles shall be offered to the public. The action of the Bell Company of Canada in these regards has been taken in accordance with the best legal advice that could be obtained in Canada, and the decision of the minister has occasioned much surprise there. The matter will be carried, if necessary, to the privy council of England. The infringing company will be at once sued under the other patents owned by the Bell Company, and in the meantime the net earnings of the company will have to be used for construction. The company is carefully managed, and its net earnings for the past year have increased to $118,952.78 on a capital of $1,000,000, and of these earnings $88,951.78 has been spent for construction.

The investment by the licensed companies of their net earnings in development has prevented such an increase of our income from our stock in those companies as we had hoped for. We received from this source in the 12 months ending February 29, 1884, $440,923, and in the 10 months ending December 31, 1884, and the sum of $317,-837.20. The two months of January and February, 1885, will bring this sum up to $465,680.20.

This year an increase is to be expected, depending in amount upon the necessity in various quarters of applying net earnings for construction.

The business of the Western Electric Company has especially felt the effects of the general depression. The gross business for the year ending December 1, 1884, was $1,534,784.04, and the net about $110.000, or 11 per cent. on the capital stock.

The question of how to consolidate its business with advantage is under consideration. Mr. W. S. Smoot, formerly with the Remington Arms Company, has been elected president, and we expect to secure an increase of business with a less expensive system of operation before long. The company has since October, 1882, put the net earnings into the business, but has just declared a dividend of 1½ per cent—$15,000.

The experimental line between Boston and New York has proved entirely successful. In was built with a metallic circuit of two copper wires (hard drawn No. 12), and was placed upon poles belonging to the several companies occupying the route *via* Providence. Conversation can readily be carried on in low tones, the speaker's voice being easily recognized. There can no longer be a question of the success of long-distance lines between all points within 200 or 300 miles of each other, and even more, when the demand for such services is of a character to warrant the building of metallic circuit systems. Such systems will be very costly, and our present licensed companies are

neither provided with capital nor organized for the purposes of undertaking a work of the proportions which commercial success in this business will involve.

It therefore becomes necessary for one company to take the lead in building lines of connection between the large cities, and a beginning will be made this summer between New York and Philadelphia.

As we have already nearly reached the limit of our authorized capital, it is necessary either to obtain authority for an additional amount, or to devise means of raising what may be required in some other way than by an increase in our capital stock. The preference for the latter method, however, being general, we have applied to the Massachusetts Legislature for authority to increase our capital to $30,000,000, in order that we may be equipped both for the work just described and for the extensive enlargement of our business in any branches that may appear desirable. It should be understood that it in not proposed to issue any part of this stock except for the development of our business.

As soon as definite arrangements can be made for going forward with the work, the directors will place before the shareholders their programme for such enterprises as it is thought best to undertake this spring and summer.

Among the inventions of the year that of a new transmitter, by Mr. Francis Blake, is prominent, and most excellent results are hoped for in its adaptation to both long and short lines. We expect to test it shortly in actual use in our own business. Mr. Blake has offered it to the company on terms which are thought favorable, provided the tests result satisfactorily.

It is hoped that this year will see the end of the most vexatious and expensive part of our litigation, and that the accumulating decisions of our courts that Bell invented the telephone will enable us to prevail with ease against the infringers in all parts of the country, and will deter capital from investing in infringing companies.

During the past year the electrical department has been reorganized and its scope somewhat extended. In the laboratory all investigations and experiments in connection with the patent litigation are conducted. In addition to these, a series of experiments on insulation materials is being conducted, with special reference to underground and cable systems.

In the patent division, the preparation of the development of the telephone system has been continued, and is now nearly complete. The usual examination of all new inventions and patents, with special reference to practicability and the state of the art, has been made. The extent of the work is best shown by the fact that up to the close of the year there have been issued 1,330 United States patents on telephone and telephonic apparatus

In view of the statements which have been circulated that the larger part of the stock of the American Bell Telephone Company represents merely water, it may be well to recall to the stockholders the fact that out of the $9,602,100 of issued capital stock about $5,000,000 has been paid in cash by the stockholders of the National Bell and American Bell Telephone companies, $190,000 represents property taken over by the National Bell Telephone Company at its organization and $105,000 is still in the treasury, and the balance represents patents. And in additional to the $5,200,000 paid in cash or property, net earnings have been used to the amount of $351,000 in increasing the plant of the company. As showing the magnitude of the telephone business, it will be interesting to know that the capital stock of the telephone companies in the United States operating under the Bell patents (omitting the American Bell Telephone Company) was on January 1, 1885, over $53,000,000. The gross earnings were partly estimated over $9,500,000, and the net earnings partly estimated $3,450,000, showing a gain over the earnings of 1883, though to what extent it is difficult to say, as some of the companies failed to report the increase and several have not been in business long enough to be able to furnish the comparison.

At this time, when the question of the rates charged to the users of telephones is being discussed, both in legislatures and by the public, it seems proper to call the attention of the stockholders to a few facts in relation to this subject.

The average cost of a connection to a subscriber varies from 3 1-10 to 5 7-10 cents, as has been previously stated. For this sum the telephone company is obliged to keep at the service of the subscriber a wire, which for a large part of the time is idle; to keep an operator ready to receive his calls at all hours; to maintain his telephone and batteries in good condition; to provide for the rapid depreciation of poles, wires, switchboard and all the apparatus of the central office, and finally to provide all the improvements in apparatus which each year developes, for the public very properly insists on receiving the most efficient service that can be given.

As an instance of the rapid depreciation of property, and of the changes likely to occur in electrical inventions, it may be well to say that the telephone system in Boston has been twice rebuilt, and the new multiple switchboards for the Boston office had hardly been received, and had not been put in place, when the invention of an improvement in detail gave such promise of excellent results that the boards were shipped back to Chicago to have the new invention added to them.

The sum then charged to the subscriber does not seem large when the cost of the service rendered by the telephone company is considered. Neither does it seem exceptional, when it is seen what the subscriber receives for his payment of three to six cents. He obtains an immediate conversation with any subscriber to his exchange, a conversation which renders needless the employment of messengers, telegraphs, and even the mail, all of which modes of communication are either slower or more costly, and often both more slow and more costly, and less satisfactory than that which is given by the telephone. The subscriber also obtains the privilege of communicating, for a small extra charge, with the subscribers of any exchange in towns or cities within a limited distance from his own. And as the number of subscribers in each exchange increases, and as the distance through which telephonic communication is possible becomes extended, the advantage to the subscriber is also greatly increased.

Finally, we may continue to hope that, as the season opens and the general business outlook becomes brighter, and as the infringing companies are one by one compelled to acknowledge the validity of the Bell patents, the telephone companies will also share in the returning business prosperity.

W. H. FORBES, President.

The treasurer's report was presented in print. A vote was passed, in conformity with the recommendation of the directors, to increase the capital stock from $9,800,000 to $10,000,000.

The officers were re-elected, with the exception of director Judge Bradley, who retires on account of ill health, and is succeeded by Charles E. Perkins. The list now stands as follows: President, William H. Forbes; clerk, Charles Eustis Hubbard; treasurer, William R. Driver; directors, Francis Blake, Charles P. Bowditch, George L. Bradley, Channing Clapp, Alexander Cochrane, William H. Forbes, Charles Eustis Hubbard, Gardiner G. Hubbard, Robert B. Minturn, Charles E. Perkins, William G. Saltonsall, Thomas Saunders.

.... At Hartford, last Friday, Judge Shipman in the United States Court, headed the arguments in the foreclosure suit of the Boston Safe Deposit and Trust Company against the American Rapid Telegraph Company. A crowd was attracted to the court room by the presence of two noted men, Roscoe Conkling, who appeared for the defence, and Col. Robert G. Ingersoll, who appeared as counsel for Daniel Robeson, who has secured an injunction against several parties, including the plaintiff and defendant in the suit. The American Rapid in August, 1883, made a contract with the Bankers and Merchants', whereby the latter were to construct additional lines to those then in use by the Rapid, and to receive $3,000,000 in bonds. The work was done, and the Bankers and Merchants' did not desire the money so much as they did the control of the Rapid. Arrangements were therefore made by the Bankers and Merchants' with a Boston party whereby the control of the Rapid was secured by exchanging these bonds for the stock of the Rapid. They secured at least 51 per cent., and have a provisional ownership of $2,500,000 in the $3,000,000 capital of the Rapid. The next election resulted in the choice of Bankers and Merchants' officers and directors, and the situation remains the same to-day. The office signs of the Bankers and Merchants' took the place of those of the Rapid, and the Rapid's message blanks went out of sight, also. The Boston Deposit Company came into possession of these bonds, and in September last the interest, amounting to $180,000, was defaulted. By the mortgage, six months must ensue before action for foreclosure. This was begun March 16, 1885. The object is to divide the property of the two companies, though the original Rapid men say the Bankers and Merchants' Company has nothing in this State but some telegraph wires and poles erected by them as mentioned, so it may be seen that the latter company is fully as much interested in this suit as the Rapid, and Mr. Conkling represents both companies. The argument of the defence was that there had never been any consideration whatever given by the Bankers and Merchants', for these $3,000,000 bonds issued to it by the American Rapid, and that the suit here should be suspended, pending the result of litigation relative thereto elsewhere. A further hearing will the held April 27.

.... A rather queer and laughable case of a too numerous message occurred a few years ago, in which a telegram went spinning around and around in a circle, covering an area of thousands of miles, at each revolution increasing itself once. The message originated at a little town in New York State, near Buffalo, and was sent to the latter place to be from there forwarded to its destination, which was also a small village in Pennsylvania, and almost unknown telegraphically. After reaching Buffalo, the "check" boy (a very necessary adjunct to all well-equipped telegraph offices, a sort of "office messenger") gathered it up with many other messages, and hunted up the location of the village. Not being able to find it (or too indifferent about it to exert himself enough to make inquiry) he sent it to Cleveland (anywhere to get rid of it). Cleveland's "check" boy being afflicted with the same disease which pervaded the entire system of the Buffalo boy, could not locate the village, and sent it to Pittsburgh. Now, there is no difference in "check" boys. They are interchangeable—all made from the same mold, and in consequence of this fact the hapless message was sent to Philadelphia, and from there promptly shoved on to New York. Of course, the New York check boy caught on to the idea that it did not belong to his part of the world, and inasmuch as it bore the marks that indicated that it came from Philadelphia, consequently it must go to Buffalo. To Buffalo it was sent. "What!" says the young sprig as he picks it up, "if here ain't another message for that village in Pennsylvania. Well, I sent the other one to Cleveland, and I'll just do the same with this." It was duly received at Cleveland, and, like its original, went the rounds again, and kept on going the rounds all day until midnight, at which hour the "all-night" man at Cleveland, dear old George Phillips, peace to his ashes, came on duty. It so happened that he sat down to receive business from Buffalo, and the very first message offered to him was this "too numerous" one, which was on its thirteenth round. He happened to know the exact location of the village so much sought after (his girl lived there), and of course told Buffalo where to send it. One of the duties of the "all-night" man was to look over all the day's business to detect any telegrams that might have been filed away without being transmitted. On the Pittsburgh file be found twelve telegrams, each an exact copy of the other.

TELEGRAPHIC

.... A. B. Chandler, formerly president of the Atlantic and Pacific Telegraph Company, will, it is said, take charge of Mr. Mackay's telegraph business.

.... A Topeka (Kan.) dispatch says a company has been organized there for the immediate construction of a new line of telegraph from Kansas City to California to be known as the Western Telegraph Company. The company has a strong financial backing and its directory is composed of western capitalists and business men.

.... Articles of incorporation of the Cheyenne Messenger and Telegraph Company were filed in the office of Secretary Morgan at Cheyenne, last week. The capital stock of the company is fixed at $3,000, divided into thirty shares of $10 each, and the legal term of existence is fifty years. The trustees of the company are G. W. Jones, A. C. Snyder, H. B. Chambers, W. R. Swan and Robert Uryhart, the first three only being the incorporators.

.... The negotiations which have been secretly going on for some time between the Bankers and Merchants' and Postal Telegraph companies for consolidation have ended in the acceptance by the Postal Company of the proposal made by Receiver Butler, of the Bankers and Merchants' for a pool between those two companies, and the Southern and American Rapid Transit companies, which are under the control of the Bankers and Merchants'. It is expected that the attorney-general will consent to this arrangement.

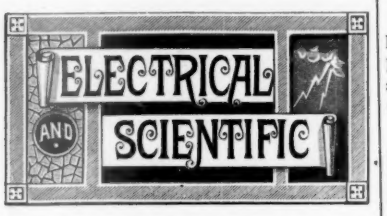
.... The motion for the appointment of a receiver for the American Rapid Telegraph, made by the trustee representing holders of about $2,000,000 of bonds, was argued in the United States Circuit Court, Judge Shipman, at Hartford, last week. Morris W. Seymour, of Bridgeport, and Colonel Wilson, of New York, appeared for the bondholders, and Roscoe Conkling for the Rapid Telegraph Company. Colonel Bob Ingersoll and Mr. Abbott, counsel in a similar motion in New York, are here, but have made no arguments.

.... The negotiations which have been pending for some time past for a pooling of the interests of the Bankers and Merchants' and the Postal Telegraph companies came to a head last Monday. Terms were arranged on which both companies agreed, and they have since been referred to the court for ratification. A decision is expected soon, but some uncertainty is expressed as to whether the agreement will be ratified. Receiver Butler, of the Bankers and Merchants', was asked the terms of the agreement last evening. He said: "The facts cannot be given until the court has acted in the matter, but the agreement provides, practically, for a separate existence of the companies. It will probably result in a restoration of rates for both parties." Asked whether rates in this city would be affected by the proposed pooling arrangement, Mr. Butler expressed the opinion that they would not.

.... The Secretary of State has received the following telegram from the president of the Central and South American Cable Company, dated March 27:

"The commander of the Colombian gunboat, Bovaca, landed at the mouth of the Buenaventura river yesterday, forced open the cable house of the Central and South American Company, and cut the company's cable, interrupting communication with South America. We have repaired damages. Will you kindly instruct the commander of the United States naval vessel at Panama. The Columbian gunboat is still at anchor at the mouth of Buenaventura river. It is uncertain whether she is co-operating with the national forces of Colombia or those in rebellion, but we fear further injury to our cabels and interference with international communication."

The dispatch was referred to the Secretary of the Navy.



* * An electric railroad will be put into operation in a few weeks in South San Francisco, and if found to work well, there is no doubt that electricity will be substituted for endless wire cables on several street car lines.

* * In a paper on the laws of solution, read before the Academy of Sciences, Paris, M. H. Le Chatelier concludes that solubility increases with the temperature for bodies whose solution absorbs heat, decreases for those that liberate heat, and remains unchanged when the heat of solution is null.

* * The *Cosmes les Mondes* states that M. Leblond has detected by the employment of lines analogous to telegraph lines, but with the extremities plunging into the sea, that there are periodical variations of intensity in terrestrial currents in direct relation with the movement of the moon or the tides.

* * One of the newest applications of paper is as a substitute for wood, in blocks or bars, wherever a knife is used in a mechanical cutter. It is also applied to blocks for shoe-cutting and cigar-making, and for the cutting blocks in envelope cutters—one outlasting a dozen of the formerly used wooden blocks. In its manufacture sheets of paper are compressed by enormous force into blocks or bars.

* * Still another wonderful use has been found for electricity. Recently electrodes connected with a dynamo of the power of forty ordinary Daniell cells were put into forty-five gallons of fresh milk, and in exactly four and one-half minutes the fluid was as dairymen say, churned, the butter rising upon the surface. The quantity obtained was fully equal to that procured in the ordinary way, and the quality perfect

* * For an artificial moon M. Brandt uses a square frame containing eight Edison lamps. The anterior face of the frame is mounted with a translucent disk. The intensity of this artificial moon can be increased to 2,000 candles, which would be impossible in so small a space with gas, on account of the excessive heat. In order to produce apparitions, on a scene which is completely dark, small incandescent lamps are screened by an opaque covering, under the gauze which surrounds the character which is to appear. At the proper moment the light is opened upon the gauze so as to make an apparition of magical beauty. In like manner the sword, in Wagner's opera, *Walkure*, is illuminated suddenly by a small incandescent lamp, the light of which seems like a ray flashing from the sword. Contrivances have also been made for making stars shine on the heads of ballet dancers, whenever desired.—*Lumiere Electrique.*

* * When a copper plate is exposed to the flame of an alcohol lamp, a Bunsen burner or an enameler's lamp, iridescent rings are produced around the heated point. Under favorable circumstances, the colors become fixed, and apparently unalterable by the air. These thermal rings are like the electro-chemical rings of Nobili; like them, they follow one another and are propagated in waves. In both cases the colors are arranged in the same order as in Newton's rings when seen by transmission. Multiple thermal rings may be formed by means of metallic ajutages attached to drums, which are surmounted by two or more gas-burners. The same apparatus may be used for the production of electro-chemical rings by placing steel needles of uniform length in the fine openings of the tubes. Decharme has sent a memoir to the French Academy, containing a comparative table and plates of the two kinds of rings, showing that the resemblance is maintained even in details. The resemblance becomes most striking when the jets of flame are small and slightly oxidizing.—*Comptes Rendus.*

* * A new electric battery has been proposed by M. de Sainte Marie. The positive pole is of lead surrounded with lead chlorate and the negative pole is of zinc plunging into a solution of lead chloride.

* * When a thin plate of steel is placed in a uniform magnetic field, so that the lines of force are normal to the surface of the plate, there is formed a very flat magnet, of which the two faces are the two polar surfaces. The magnetic distribution, thus obtained, seems to disappear as soon as the plate is removed from the field. M. Duter employed tempered steel plates, with the thickness of a millimeter and diameters varying from 5 to 40 mm., with which he formed cylindrical piles. In some of these piles the plates were directly in contact, while in others they were separated by the use of paper or pasteboard. The piles were placed in the central portion of a very powerful magnetic field, and, after they were withdrawn, they constituted regular permanent magnets, the sustaining force being greater in proportion as the plates were closer to one another. On dismounting the piles and carefully marking the upper and under surfaces of each plate, the magnetism was hardly perceptible; but when the pile was reformed, there was again a magnet, although weaker than at first. The separation of the magnet into its constituent elements and its reconstruction can be continued indefinitely.—*Comptes Rendus.*

Electricity in the Household.

Professor George F. Barker, of the University of Pennsylvania, delivered a lecture on the above subject in Philadelphia last week.

The lecturer stated that modern physical science took cognizance only of matter and energy, and that these two were inseparably connected. Matter was valuable either intrinsically or for the sake of the energy in connection with it. For example, coal was valuable, not for itself, but for the sake of the heat which was liberated by its combustion. It is impossible for us to increase the amount of either matter or energy which already exists—to create either, but it is possible for us to transform energy from a cheap to a more valuable form. The whole question of modern science is, therefore, to accomplish this last-named object. To produce light we take advantage of the power stored up in combustible bodies, and liberate it in the desired form by combustion. Combustion has been, until very recently, the only practical means of generating either light or heat, but of late years electricity has been made use of for this purpose, and the question has become one of how cheaply and practically to transform electricity into light, heat and power.

Just ten years ago Professor Barker said he had exhibited upon the stage of the Academy the first Gramme machine ever brought to this country, and he might safely say that the invention of that machine had solved the problem of how to turn power into electricity.

LIGHT BY MEANS OF ELECTRICITY.

To produce light by means of electricity is as easy as to procure it by combustion. It is only necessary to oppose or interrupt the passage of electricity to generate both light and heat. If the two terminals of an electric circuit are touched together and again separated, a brilliant flash of light, varying in color with the material of which the electrodes consist, is produced. In 1801, Sir Humphrey Davy, in investigating this subject, found that when the terminals consisted of carbon the light approached more nearly to that of sunlight than any other. In investigating the mechanism of the production of the arc light it is evident, said the lecturer, that it is produced by the resistance introduced. Air is a very poor conductor of electricity, and when the electrodes are separated by a small interval the resistance to the passage of the current results in an actual detachment of particles of matter from the poles, and their being heated by the resistance to intense incandescence. The lecturer projected an image of the terminals of an arc light upon the screen, demonstrating the intense incandescence of the particles of matter at the poles and the constant detachment of intensely heated particles from the poles. On analysis by means of a prism the light emitted from the arc is found to be richer in the blue rays than is sunlight at the surface of the earth. It is not, however, necessary to actually break the current to produce light, nor to interpose such a highly-resisting body as the atmosphere. If any poor conductor is interposed in the circuit of a current of sufficient quantity, it will become heated by the resistance which it offers to the passage of the current. If the resistance is sufficient the substance becomes heated to incandescence and emits light. Carbon is the only substance known which is capable of being heated to such a point without change, and, consequently, it is the substance utilized in all of what are so well known now as incandescent lamps. The transformation of energy is by no means so complete in the incandescent as in the arc light, but besides being less blue, the light is steady and the current may be subdivided to any desired extent, so that for household use it might be said that the incandescent light was the only one practicable.

INCANDESCENT LIGHTING.

The consideration of incandescent lighting divides itself into the generator, the conductors, the lamps and fixtures, and finally the safety devices. Concerning the first two subjects, Professor Barker had but little to say, except that for three years over 12,000 lamps had been in constant use in the Edison system in New York, all of which were supplied with underground conductors. The lamp in the Edison system, which he took as the type of incandescent lighting, consists of a filament of charred bamboo fiber, enclosed in a glass globe exhausted of air. The meter of the same system was also explained, and the lecturer stated incidentally that the charge made by the Edison Company was 1¼ cents per lamp per hour.

The safety of any system of electricity, he continued, depends entirely upon the character of the current employed. Sir William Thomson had stated that any current of over 200 units of pressure was too dangerous to be introduced into a house. The arc lights in ordinary use require 2,500 units, but the incandescent system never uses a greater pressure than 100 units. The lecturer illustrated the perfect safety of the system by grasping the terminals directly at the generator of a circuit, on which about 50 lights were running. The safety plug of the Edison system, consisting of a leaden wire, capable of carrying the necessary amount of current, but which melted under an increase of pressure, was shown, and its use illustrated. Finally, the lecturer, to illustrate the perfect safety of the system, broke a lamp enclosed in his handkerchief, without the slightest effect except the extinguishment of the light. He stated that the manager of the Edison system in New York had decorated his Christmas tree with 120 incandescent lamps, with which his children played—a result, the lecturer stated, absolutely impossible with any other means of illumination.

ELECTRICITY AS A MEANS OF POWER.

The utilization of electricity as a means of power in the household was illustrated by the practical use of a sewing machine and a lathe driven by electric motors upon the stage.

The question of economy is really the important one to be solved in the introduction of electricity to all these various uses. In this connection the lecturer quoted some interesting figures. The amount of energy given out by a standard sperm candle is found by experiment to be 13 1-10th foot-pounds per minute, but to get one candle-power from a tallow candle requires the expenditure of force equal to 4,630 foot-pounds. In other words, less than a third of one per cent. is utilized by light. Wax requires 4.506 foot-pounds to be expended per candle-power; paraffine, 3,970; illuminating gas, 2,166; incandescent lamps, 2,000; and arc lamps, 303 foot-pounds. By no known means can we utilize as light more than four per cent. of expended power.

THE STEAM ENGINE.

The lecturer said he had no hesitation in charging this tremendous wastefulness upon the steam engine. He considered it as one of the most wasteful machines known to science. The best of them only utilized ten to twelve per cent. of the energy in the coal. Improvements are to be made in this direction in the future; and in this connection he had great satisfaction in exhibiting what he looked forward to as an indication of the means of power of the future. A small thermo-electric battery running a small incandescent lamp was then exhibited. Here the direct transformation of heat into electricity is accomplished. Already by this machine one per cent. of the energy was utilized. When the percentage of power saved, by improvements or new discovery, amounted to ten per cent., he believed the days of the steam engine would be numbered.

The lecture was profusely illustrated throughout, a handsome revolving electric fountain decorated with incandescent lamps occupying the center of the stage, the power being generated by a small steam engine, also on the stage.

Testing a Dynamite Gun.

HEAVY PLATES OF IRON BROKEN INTO SPLINTERS BY THE AID OF A NEW ELECTRICAL EXPLOSIVE FUSE.

Thirty or forty gentlemen and ladies, who had been waiting for some time, successively shook hands with Captain Copeland, of the harbor police, when the gang-plank was thrown off, and accepted his invitation to step into the cosy cabin. It was not an excursion, although the party enjoyed the fine weather and beautiful sail down the bay as far as Fort Lafayette, where the Patrol made fast The gentlemen were attracted thither to witness the havoc that could be caused by a dynamite projectile that is designed to cause great destruction to fortifications and ships of war. It was the first public exhibition of a novel and ingenious contrivance for exploding powerful projectiles.

Lieutenant E. L. Zalinski, of the Fifth Artillery, stationed at Fort Hamilton, welcomed the party to the old fortress. He was the hero of the day, for he is the inventor of the improvement which, it is claimed, will blow up the naval armament of any nation should it come off our shore with hostile intent.

Near the landing was a curious machine not unlike the boom of a dredging machine. This, the Lieutenant explained, was the famous pneumatic dynamite gun which the United States Government has ordered to be tested thoroughly preparatory to its adoption by the Navy Department as a weapon of defence and aggression. From time to time numerous improvements have been made on it, and it is now controlled by the Pneumatic Dynamite Gun Company, of New York, of which Spencer D. Schuyler is the president. About a year ago the Government ordered it to be tested.

It has been found that ordinary percussion fuses for discharging heavy projectiles are not reliable. If 60 per cent. of those employed did their work, the result was considered satisfactory. But Lieutenant Zalinski has made it a study to discover, if possible, something that could be relied on. He thinks he has found it, and the passengers on the Patrol yesterday went down to see if he had.

He is the inventor of an electrical explosive fuse that was patented March 3. It consists of a miniature battery three-fourths of an inch in diameter and one and a fourth inches long. The ordinary "plunger" in a shell fuse is substituted for the Zalinski battery. By this it is possible to control the time and point of explosion. More than one battery can be used in a projectile, and the latter simultaneously exploded in several places. This is the first time that a battery has been put in a projectile to discharge it.

In yesterday's experiment a long cylindrical projectile was used. It was charged with six pounds of Nobel's explosive gelatine, of

which the United States Government purchased two tons some time ago in Glasgow for experimental purposes. This is more powerful even than dynamite, and can be more safely handled. Into the projectile was inserted the battery, so arranged that at the time of contact an electrical connection would be formed and an explosion take place. Everything in readiness, it was inserted in the gun. It was pointed at a target sixty yards distant and discharged by compressed air. The pressure was 500 pounds to the square inch.

A thundering detonation was heard several miles away, and the walls of the old fort shook. Splinters of boiler iron and pieces of brick and masonry flew in all directions. On investigation, it was found that the projectile had struck squarely a chalk mark on a large sheet of half-inch boiler iron, at which it had been aimed. It shattered that and made a jagged hole through three others, aggregating five inches in thickness. The little battery, it is claimed, can explode any projectile, no matter how large, and do its work when the latter strikes the mark.

Another experiment will be made on Saturday, when a regular target for monitor practice will be used instead of the sheets of boiler iron. The Government intends tearing down the walls of Fort Lafayette and rebuilding it. Lieut. Zalinski has asked permission to raze the old fortress by hurling projectiles at it.

"Electro-Magnetic Induction."

ITS APPLICATION TO THE NEW METHOD FOR ESTABLISHING COMMUNICATION BETWEEN RAILROAD OFFICES AND MOVING TRAINS.

Frank Kitton, chief operator of the Western Union Telegraph Company at Buffalo, highly entertained the members of the Buffalo Electrical Society last week with his discourse on "Induction," and particularly in its application to the method by which telegraphic communication may be established between railroad offices and moving trains.

Mr. Kitton started out with the statement that the discovery of "induction" was made by Faraday in 1830. "Induction" was the name of certain effects produced in a wire or other conducting body, by an electric or magnetic force acting upon it from a distance. For example, if a wire conveying an electric current were placed near another wire which included in its circuit a galvanometer, the latter would indicate a momentary deflection, first in one direction, and then in the opposite direction, every time the wire through which the current is flowing is opened and closed. The lecturer here demonstrated this phenomenon. Placing two coils of wire, one of small and the other of larger diameter, in close proximity to each other, and connecting the two ends of the thicker wire with a battery of a few cells, contact was made and broken by means of a telegraph key. At each motion of the key the galvanometer inserted in the circuit of the thin wire became deflected. Replacing the galvanometer by a receiving instrument, called a polarized relay, Mr. Kitton showed that the signals transmitted through the heavier wire affected the relay attached to the extremities of the thin wire. The wire through which the battery current is flowing is called the "primary" wire or circuit, and that in which the momentary effects are produced "secondary" wire or circuit. Several messages were then forwarded over one wire and received upon the other with the most perfect success. It was explained that this phenomenon was known as "electro-magnetic induction," to distinguish it from "magneto-electric induction," the latter being generated by means of permanent magnets.

It was a well known fact, Mr. Kitton said, that whenever an armature was moved across the lines of force of a magnet covered with wire, that electric currents were induced in that wire. Of this he gave a practical demonstration, and also that a magnet inserted into and withdrawn from a coil of wire produced similar effects in the wire. He proceeded to illustrate experimentally how the increase and decrease of magnetism in the cores of an electro-magnet produced induced currents in the helices of wire encircling its cores. Connecting the ends of an electro-magnet to a galvanometer, a horseshoe magnet was brought near the electro-magnet and immediately the galvanometer showed a momentary deflection of about fifty degrees. Upon withdrawing the magnet the galvanometer was again affected, but in an opposite direction. A relay was now put in place of the galvanometer, and each time the permanent magnet approached to and receded from the electro-magnet an audible signal was recorded on the relay. By making a series of motions with the magnet in front of the coil, Mr. Kitton was enabled to distinctly induce Morse characters in the relay, which could be read by every one present.

This principle, he said, had been applied to telegraphy, and with great success. The telephone was merely an application of the principle of magneto-electric induction, for every time the disk of that instrument vibrated under the influence of the voice, electric currents were induced in a helix of wire placed upon one of the poles of a bar magnet, and were transmitted over the wire to the distant telephone, and by alternately increasing and decreasing its magnetism set its diaphragm in motion and so produced sound waves. A telephone was here inserted in the secondary wire of an induction or "shocking" coil, and the rapid vibrations of the "vibrator" were loudly reproduced in the telephone. A key was next put in the primary vibrating circuit, and a series of telegraphic characters were made, which were duly recorded by the telephone in an unmistakable manner. This latter experiment, Mr. Kitton explained, would enable his audience to understand how it was possible—and, indeed, practicable—to establish communication between a moving train and the various railroad offices along the line. In the first place an insulated copper wire, suitably inclosed, was run along the railroad track midway between the rails. This might, for the present, be called the secondary wire. Underneath a car, fitted with the necessary instruments, was placed an iron pipe (running the whole length of the car), in which was placed the primary wire, which first passed through the pipe was then brought up into the car and strung along the top, after which it descended through the car into the pipe again, and so on, until the latter contained about ninety convolutions of wire, the ends of which terminated in suitable telegraph apparatus. Every time, therefore, the telegraph operator in the car manipulated his key he caused a strong current to flow in the wires contained in the pipe, which was placed at a distance of about 7 inches from, and parallel to, the wire on the track. An induced current traversed the wire, which was led into the different offices, and there connected with a similar set of apparatus. This apparatus received the induced electric impulses and rendered them intelligible to the receiving operator. The reverse of this was also true. When a dispatch was forwarded from any of the offices to the train, the currents traversing the wire between the rails were inductively taken up by the parallel wires under the moving car, and conveyed to the receiving instrument, to be there translated by the receiving operator.

Mr. Kitton proceeded to show in detail how this was accomplished, making his description very clear by means of blackboard and other illustrations. This system had been recently perfected by L. J. Phelps, and marvelous results had been obtained in a practical test on a stretch of railroad extending from the Harlem River to New Rochelle Junction, a distance of about 12 miles.

Lighting Trains by Electricity.

For some time the officials of the royal railways at Frankfort-on-the-Main, have been experimenting with the electric light for railway coaches. These experiments have been undertaken on a large scale, and it is stated, have at length been crowned with perfect success. The line between Fulda and Sachsenhausen has been chosen, a distance of 106 kilometers. The train employed consists of a baggage car, two coaches of the first and second classes and one of the third class. The baggage car was used for the reception of the dynamo and of twenty-six accumulators. Under the coach, and directly under the dynamos, were placed truncated cones corresponding to second truncated cones attached to one of the axles of the coach wheels. The arrangement of the cones is such that the speed of the dynamo shall be constant when the train is moving at speeds varying from 30 to 70 kilometers per hour. The transmission of the power to the dynamo and to the regulator (which is necessary owing to the varying speed of the train) is effected by differential gearing and an arrangement of pulleys. By the aid of a gyrotrope, the circuit in which the dynamo is inserted is instantaneously broken as soon as the train stops, or goes slower than 30 kilometers per hour, and at the same instant, by the same arrangement, the accumulators are switched into circuit. When the train is running at full speed the charging of the accumulators is effected, the lamps being in circuit, so that the current of the dynamo passes through the accumulators to the lamps. During the day the lamps are not in circuit, and the accumulators are charged during the runs.

The weight entire of the apparatus under the baggage car, which is enclosed in a wooden casing, and of the dynamo and accumulators is 600 kilogrammes (1,320 lbs.). The installation cost nearly 2,500 marks ($600). There are in the train twelve incandescent lamps of which two are in the baggage car, two in the third-class coach, and eight in the coaches of the first and second classes; but the machine and accumulators are of sufficient capacity to light two more coaches.

The installation in the coaches cost sixty-five to eighty marks ($15.60 to $19.20) per coach. The expense of maintenance per lamp per hour being very near 0.8 pfenings (about $\frac{1}{8}$ of a cent).

The light was found to be very steady for the variable speed of the train, and also during the stops at the stations.

It was only at entering and leaving that one would perceive a slight flicker in the light, caused by changing from the dynamo to the accumulator circuit. During a service of six months the accumulators did not lose their capacity for charge, nor their efficiency. During a trial trip they served to feed the lamps for 55 minutes, after a preliminary charging for four hours, and after a rest of 24 hours they still gave a current sufficient to light the train for an hour, and the day following during 45 minutes.

The installation is noteworthy, in that all the regulating, switching, etc., are effected automatically by one and the same mechanism, the conductor of the train having but to turn a switch to put into operation the entire apparatus.—*La Lumiere Electrique.*

Speaking of long circuits one of our principal operators said recently: "Yes, I've worked over some very long circuits in my time. There are few longer in the world, except cables, than the overland from Chicago to San Francisco. The longest continuous circuit I ever knew of, personally, was one connected up one Sunday, years ago, by 'the boys,' just to see how far they could make 'the old thing' go. It was from Galveston, Tex., to Portland, Ore., going through the following places: Galveston to New Orleans, to Montgomery, Ala., to Richmond, Va., to Washington, D. C., to New York, to Albany, to Buffalo, to Cleveland, to Chicago, to Omaha, to Salt Lake City, to San Francisco, up to Portland. It worked very nicely, considering there were eight pairs of repeaters in the circuit.

"The only difficulty encountered was that the operators out West were all originally from the East, and every man on the entire line wanted to talk to some one of the others that was beyond his reach ordinarily. The result was that there was a continuous contention for the 'right of way,' resulting finally in the wires being disconnected. A test of time and speed over that distance was contemplated, but for the above reason was abandoned."

ELECTRIC LIGHT NEWS

—— The Schuyler Electric Light Company, of Hartford, Conn, have closed a contract with a delegation of capitalists from St. Louis, Mo., for a plant of 100 lights in that city.

—— A company has been formed at West-Chester, Pa., for electric lighting. Messrs. Cornwell & Hemphill are the principal men engaged in it. It is understood that the capital is all paid in, and they are now awaiting bids from the different companies to furnish plant.

—— One hundred and sixty Edison incandescent lamps are to be placed in the Milwaukee Opera House, to be run by a Fuller machine. M. P. Hathaway, the gentleman in charge of the work, first experimented with forty lamps, and as a result will now light the entire Opera House.

—— On Saturday evening a number of capitalists of New York, Newark, Elizabeth, and other cities met at the Sheridan House, in Elizabeth, and organized what will hereafter be known as the "Eastern Electric Company," with a capital of $250,000. The following were chosen Directors: Robert S. Green, F. M. Waterbury, F. W. Stillman, and W. H Gillett, of Elizabeth; Dr. H. A. Johnson, of Easton, Pa., and George S. Bowen, of Chicago. Afterward the following officers were elected: President, Robert S. Green; Vice-President, H. A. Johnson; Treasurer, T. M. Waterbury; Secretary, James McK. Graeff; and W. H. Gillett, Superintendent. The purpose of the Company is the introduction and sale of electric motors for surface and elevated roads.

—— People in this country who are required to pay from $2 to $5 per thousand feet for very inferior gas, have reason to envy the gas users in Europe who get all they want for about half a dollar per thousand feet. Even this price, which to us would seem trifling, is not paid without complaint, but gas users over there have recently been gratified by announcement that an invention has been perfected that will cheapen gas so that it can be sold at two cents per thousand feet. Our gas users would not mind getting some of the benefits of that invention. Yet the use of gas as an illuminant has had its day, as electricity is fast superseding it in this country.

—— Some talk is being made in Boston in regard to an incandescent lamp which the inventor claims will eventually revolutionize the present system of using glass globes, as this lamp does not require a vacuum, therefore a covering is not essential. The filament is composed of a platinum wire covered over with a non-combustible material which will expand and contract with the platinum wire, when heated, without cracking or peeling off. However, the limited time these lamps have been tested, give as yet no assurance of their durability. Electric light companies here are very shy in the matter of taking any stock in this so-called Dr. E. B. Sarchar's lamp, and it is the object of the inventor to organize a company to assist him in developing his new invention.

—— The following regulations governing the introduction of electric lights into buildings were adopted by the Board of Fire Underwriters, of St. Louis, Mo., to go into effect April 16th.

"That the machine be perfectly insulated from the ground; that the wires start at as great an angle from each other as practicable; that they start on their journey in opposite directions; and that under any circumstances they be not allowed to come nearer together than one foot; that all joints of wire in the building be soldered without acid; and that, as far as practicable, they do not come nearer than one foot from any iron, and that when they come nearer they be protected by double covering; that all lamps be closed at the bottom, and that the lamps be insulated."

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING MARCH 31, 1885.

314,567 Electric arc lamp; Phillip Diehl, Elizabeth, N. J.

314,568 Conduit for electric wires; Josiah S. Du Bois, Camden, N. J.

314,634 Secondary electric clock; William F. Weisgerber, New York, N. Y.

314 655 Conduit for electrical wires; Matthew H. Devey, Chester, Pa.

314,709 Electro-magnetic car brake; Harvey S. Park, Henderson, Ky.

314,722 Electric battery; Isaiah L. Roberts, Brooklyn, N. Y.

314,760 Electric railway signal; William T. Waters, Atlanta, Ga.

314,761 Electric railway signal; William T. Waters, Atlanta, Ga.

314,762 Electric railway signal; William T. Waters, Atlanta, Ga.

314,763 Electrical railroad signal; William T. Waters, Atlanta, Ga.

314,791 Conduit for electric wires; David Brooks, Jr., Philadelphia, Pa.

314,816 Induction coil; Frank E. Fisher, Detroit, Mich.

314,817 Mechanism for operating telephone night bells; Frank E. Fisher, Detroit, Mich., assignor to the Detroit Electrical Works, same place.

314,818 Telephone line switch; Frank E. Fisher, Detroit, Mich., assignor to the Detroit Electrical Works, same place.

314,819 Talking strap for telephone switchboards; Frank E. Fisher, Detroit, Mich., assignor to the Detroit Electrical Works, same place.

314,841 Telephone transmitter; George M. Hopkins, Brooklyn, N. Y.

314,891 Electrical indicator; Frank J. Sprague, New York, N. Y.

314,892 Secondary battery or electric accumulator; Eli T. Starr, Philadelphia, Pa., assignor to the Starr Electric Storage Company, Camden, N. J.

314,914 Apparatus for measuring the flow of liquids; William A. M Brown and John M. Porter, Leeds, County of York, England, said Brown assignor to Frederick Maskell King, same place.

314,976 Means for suspending electric lights; William H. O. Beire, Fort Wayne, Ind., assignor to the Star Iron Tower Company, same place.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.

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